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ABSTRACT

The term "ipsative" refers to measurement based on intra-individual comparisons. The research literature in the social sciences contains many cautions about using ipsative data in multivariate analysis. The purpose of this paper is to identify the problems associated with the multivariate and regression analyses of ipsative data and to provide recommendations for avoiding these problems. Ipsative scales have been mainly employed by researchers in the area of personality measurement, vocational choice, and the assessment of values and attitudes where the scale values are interrelated. Due to this interrelatedness of the scales, many problems can arise when multivariate and/or regression analysis procedures are used to analyze the data obtained from ipsative measurement. Such an analysis would produce a singular correlation or covariance matrix that cannot be inverted. The results of the analysis can be inflated or deflated relationships that are artifacts of the forced distributions. While counselors, clinical psychologists, and other clinicans may have valid uses for ipsative measures, these same measures may not be appropriate for research purposes where multivariate and regression analyses are used. This study recommends that multivariate or regression analysis should not be performed on data obtained with ipsative measurement. Other alternatives are to use normative rather than ipsative measurement, or to reduce the interrelatedness of the scales by deleting one of the ipsative scales or adding a normative scale. (JAZ)

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MULTIVARIATE ANALYSIS OF IPSATIVE DATA: PROBLEMS AND SOLUTIONS

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MULTIVARIATE ANALYSIS OF IPSATIVE DATA; PROBLEMS AND SOLUTIONS

The term "ipsative" as coined by Cattell (1944) refers to measurement based on intra-individual comparisons. Thus, scale values for an individual resulting from ipsative measurement are interrelated. The research literature in the social sciences contains many cautions about using ipsative data in multivariate analyses but, at the same time, includes many examples of applications of multivariate analyses of ipsative data. The major warning about using ipsative data for multivariate analyses is that multivariate analyses require the inversion of the correlation or covariance matrix and that matrix is singular when ipsative measurement is used. Thus, the process involves a division by zero.

The purpose of this paper is to identify the problems associated with the multivariate and regression analyses of ipsative data and provide recommendations for avoiding these problems. The paper presents the background for the topic, a discussion of problems resulting from performing multivariate or regression analyses with ipsative data, and some recommendations for avoiding these problems.

Background

Ipsative scales have long been a part of measurement procedures employed by researchers. Some of the earliest work that could be described as ipsative measurement was done by Stephenson (1935), and later labeled Q-Technique or Q-Methodology (Stephenson, 1953). Cattell (1944) coined the term "ipsative" in an article describing three forms of psychological measurement--interactive, normative, and ipsative. Ipsative was derived from the Latin word "Ipse" meaning he, himself. Therefore, ipsative measures are related to the strength

and weaknesses of an individual and are not compared to other individuals as is the case with normative measures.

Ipsative scales are most prominent in the areas of personality measurement, vocational choice, and the assessment of values and attitudes, and over the years, many scales have been developed that employ ipsatization to some degree. These scales range from a "perfectly ipsative" measure such as the Edwards Personal Preference Schedule to "partially ipsative" measures such as the Strong-Campbell Vocational Interest Inventory.

Perfectly ipsative measures are those that yield the same total scores for all respondents and the development of such scales can be accomplished in several ways. One method is to use a forced-choice format in which each item is compared to every other item. Another way to develop ipsative measures is to assign each respondent the same number of points and have them allocate these points among several subscales. A third, and the simplest method, is to have respondents rank order a number of stimulus items.

Partially ipsative measures occur when the response format may also be forced-choice, but the respondent chooses among three or more alternatives as in the Kuder Preference Record--Vocational. A measurement in which the same items occur in more than one scale is another type of partially ipsative measure. Examples are instruments such as the Minnesota Multiphasic Personality Inventory and the previously mentioned Strong-Campbell. Thus, ipsativity is made more complex by introducing a degree of ipsativity that can be considered on a continuum from perfectly ipsative to not ipsative at all.

Another consideration is the method of producing an ipsative score, or set of ipsative scores, for an individual. One procedure produces empirically ipsative or experimentally ipsative scales as a result of using forced-choice

items. Use of a forced-choice format was introduced in personality testing to overcome problems of response bias such as faking and producing socially desirable responses. Stephenson (1953), in using Q-Sorts, was interested in comparative responses and not absolute responses, as many researchers still are today. The choice of comparative procedures for collecting information was predicated on the problems arising from working with human respondents, and resultant problems with statistical analyses were not, and still are not, considered as important by many researchers.

A second method of producing ipsative scores is to mathematically transform raw or normative scores to an ipsative scale. In this procedure, a set of scores for an individual is used to produce an individual mean; then the various scores are compared to that mean and standardized such that each person's total score is a constant. On the other hand, it is not possible to go from scales that are originally ipsative to normative scales. That process is analogous to unscrambling eggs.

The procedure for producing ipsative scales introduces a second issue in the problem of how to deal with ipsative scores. For the purposes of this paper, we will limit our discussion to empirically derived scales that are purely ipsative. This restriction may not be as limiting as it first might appear. The problems that arise from using purely ipsative measures in research will still be present, but to a lesser degree with partially ipsative measures. Thus, recommendations for avoiding the problems of purely ipsative measures may also reduce problems associated with partially ipsative measures.

This paper deals with the use of ipsative measurement using multivariate and regression analyses. The term, multivariate analysis, in this paper refers to all procedures that use a multivariate dependent variable. Strictly

speaking, linear regression does not fit that definition since it can have a univariate dependent variable. However, fitting regression equations is subject to the same problems when using ipsative measures as the multivariate analyses that are addressed in this paper. Examples of multivariate analyses include discriminant analysis, factor analysis, canonical correlation analysis, and multivariate analysis of variance.

Problems

"How's your wife?" is the question. "Compared to what?" is the response. This old joke, usually attributed to one-liner comedian Henny Youngman, describes a problem sometimes encountered in educational and psychological measurement. That problem is when and where to use ipsative scales in research. From its earliest application until the present day, some 50 years later, controversy and misinformation regarding ipsative scales abound.

In research studies, many problems can arise when multivariate and/or regression analysis procedures are employed to analyze data obtained from ipsative measurement, and these problems are a result of the interrelatedness of the scales. Specifically, the fact that there is always a degree of correlation among ipsative scales due to the nature of the ipsative procedure produces a variance-covariance or correlation matrix that cannot be inverted.

As mentioned previously, Stephenson (1935) produced some of the earliest work with comparative procedures and later authored an article (1936) describing Q-Analysis as a type of factor analysis. At the same time there was disagreement with both the methodology and the analysis methods used. Burt and Stephenson (1939) combined to author an article in Psychometrika stating their areas of disagreement. Later Guilford (1952) warned against the

use of ipsative scores in factor analysis:

> It is improper to use normative scores in a Q-Techniques analysis and to use ipsative scores in an R-Techniques analysis. Unfortunately both of these mistakes are sometimes made. (p. 31)

Still later Nunnally (1967) in a chapter of his book dealing with special issues in factor analysis warns:

> A fourth way to fool yourself with factor analysis is to employ variables that are experimentally dependent. (p. 369)

Clemans (1966), in a monograph dealing with the properties of ipsative scores, worked with mathematically ipsative scales and did not indicate that either ipsative or absolute scales were of superior quality.

A more recent and comprehensive review of the literature concerning ipsative measures was conducted by Hicks (1970). Part of his findings are as follows:

> An examination of careful methodological studies of purely ipsative measurement techniques indicates that many researchers are unaware of the narrow limits within which interpretation may validly proceed and standard statistical techniques may legitimately be applied. (p. 181)

The basic problem associated with multivariate and/or regression analyses of ipsative data is that such an analysis would produce a singular correlation or covariance matrix if no measurement error were present and the measurement error may permit the data to be analyzed from a strictly mathematical sense. However, the results of such analyses may be inflated or deflated relationships that are artifacts of the forced distributions.

Studies with factor analyses of ipsative data have demonstrated this often results in factors with artificially high and low alternating loadings and uninterpretable results (Davis & Chissom, 1981; Flaitz, 1984). Flaitz (1984) also compared factor solutions of data collected with an ipsative instrument (Part One of the Study of Values; Allport, Vernon & Lindzey, 1960)

and a parallel non-ipsative instrument and found they were not comparable.

An additional problem with using ipsative data in factor analysis is the large percentage of negative relationships that occur because of the forced choice nature of the ipsative measures (Clemans, 1966; Davis & Chissom, 1981; Hicks, 1970). In fact, Clemans (1966) found that about two-thirds of the factor loadings would be negative. The negative relationships are often difficult to interpret in terms of the original data.

It has been shown that a correlation matrix based on ipsative data results in mean correlations with upper and lower limits of $(n - 4)/n$ and $-1/(n - 1)$ respectively where n is the number of scores (Anderson, Ball, Murphy, & Associates, 1975). This finding confounded by the interrelatedness of the measures, suggest that ipsative measurement may not be appropriate for any type of multivariate analysis. Often, measurement error is sufficient to overcome these mathematical restrictions to the analysis and provide the researcher with a false sense of security concerning the results. If a correlation matrix or its corresponding covariance matrix theoretically cannot be inverted, a required step in all multivariate analyses, doing so would result in a solution based on statistical error. Thus, discriminant analysis, canonical analysis, and multivariate analysis of variance all may produce questionable results when applied to ipsative data.

A similar problem arises when applying regression analysis to data produced with ipsative measurement. The professional literature has many cautions about the problems with multicolinearity in regression analysis (e.g., Massy, Lodahl, & Frank, 1966). The use of only ipsative measures as the independent variables in a multiple regression would be an extreme form of multicolinearity since by definition the variables are interrelated.

The aforementioned problems concerning the use of ipsative measurement with multivariate and regression analyses are brought more into focus when the audiences of such studies are considered. Many consumers of such research do not have the background or statistical expertise to challenge the results produced by such studies. Who would question results produced by a sophisticated computer using sophisticated software to perform a sophisticated statistical procedure?

Recommendations

Ipsative measures were developed originally and still may be most appropriate for clinical applications. Their greatest virtues may be their ability to overcome the social acceptability biases of an instrument and compare ones strengths and weaknesses against each other. While counselors, clinical psychologists, school psychologists, and other clinicians may have valid uses for ipsative measures, these same measures may not be appropriate for research purposes where multivariate and regression analyses are used. Thus, the most conservative recommendation is to not perform multivariate or regression analyses on data obtained with ipsative measurement. This recommendation is supported by empirical and theoretical research cited in this paper. Based on this recommendation, the primary alternative is to use normative rather than ipsative measurement in the first place.

However, equivalent or even appropriate normative measurement alternatives are not always available to the researcher. Does this mean that the research effort must be abandoned? Not necessarily. There are less extreme alternatives that may provide satisfactory solutions to this methodological problem.

Since the basic problem related to using ipsative data in multivariate

and regression analyses is its total interrelatedness, steps can be taken to reduce the interrelatedness. Deleting one of the ipsative scales would accomplish this as would adding a normative scale. Both solutions would produce variability among the total scores for each individual rather than the constants produced by purely ipsative measures. It is interesting to note that dropping an ipsative scale would not affect the results regardless of which scale was dropped (Anderson, et al., 1975).

The least conservative approach to using ipsative data in multivariate research is to proceed with the analyses, recognize the problems, and exercise caution during the interpretation phase. This approach should only be used in confirmatory studies and should be avoided in shotgun or exploratory studies with ipsative data. In any case, a multivariate or regression analysis of ipsative data should be cross-validated.

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